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LABORATORY TEACHING OF LARGE CLASSES.*

TEACHING may be subdivided into two kinds: First, that which cultivates the fac-

*Annual discussion before the meeting of the American Society of Naturalists, Baltimore, December 27, 1894. The continuation of this discussion by Professors Bumpus and Ganong will be published in the next issue of SCIENCE.

ulties of the individual, increasing his ability to work for himself and enabling him to use his intellectual powers with confidence in the acquisition of knowledge. Second, that which disregards or takes for granted that he has these powers at his command and strives to increase his store of information. The first process is the improvement and building up of the intellectual forces by any means that will enable them to do their work thoroughly and correctly, and the second is practically, except in so far as it can be used in carrying on the first process, a load carried by the brain. Similar in fact, though not in kind, to the extra fats and extra growths, of all sorts carried by the body, it may sometimes be of advantage, and sometimes, when in unnatural proportion, a serious and perhaps even an injurious burden.

The cultivation of the original powers of the individual, of his whole mind, with, of course, proper regard for moral and physical well-being, which are, in my opinion, equally important and essential, is akin to the treatment by which a good teacher of athletics strives to improve the native strength of a pupil and give the muscles endurance and force, and which the young gymnast himself is taught how to use to the greatest advantage. This athletic training must go hand in hand with judicious feeding, and in the parallel processes of education similar objective training must go hand

in hand with a legitimate amount of information. It is striving against nature to throw a pupil wholly on his own resources and allow him to find his way alone. This effort not only wastes valuable time, but it is an attempt to return to primitive conditions and to produce unfavorable surroundings that do not exist at the present time. This kind of teaching is fortunately very rare nowadays, and usually an ideal that it is impossible to pursue consistently in actual practice.

The natural and right course is really followed by a very good teacher, and strives not only to exercise and train his pupil's faculties, but at the same time or at proper intervals furnishes information that will give needed nourishment and renewed strength to his power of doing pioneering work, if he be capable of this higher order of effort.

The happy combination of self-culture and sufficient intellectual meals is by no means easy, and they are mingled in due proportion only when the pupil can be employed for much the largest part of his time in the handling of objects or experiments under proper direction, which will enable him to build up by his own experience methods suitable for his own mind, or, failing that, to at least learn how original work has been done by others.

Laboratory teaching is an effort made now by all institutions to furnish proper facilities for practical instruction of this sort, and it is successful or the reverse, according to the proportions in which the system adopted deviates from the happy medium in which neither self-culture nor the administering of information is allowed to usurp the whole field.

This being a partial description of Laboratory teaching, it is a question in the minds of most naturalists whether it is in a strict sense applicable to large classes except under very exceptional conditions. In the

first place, what is a large class; is it forty, eighty, or one hundred and sixty? Can the class be taken in sections or must it be handled as a whole? Can the instructor command laboratory facilities in the shape of rooms, tables, specimens or instruments, and materials for observation or experiment, and, above all, can he command assistants? All of these queries must be replied to in some shape by each instructor before it is possible for him to consider the subject from any practical point of view.

It is obvious that laboratory exercises and information must be individualized to be of the highest standard, and this could not be carried out fully by an instructor alone, except for a small class. There is also an obvious limitation of numbers due to the necessary limitation of facilities that can be offered by any institution, however well equipped. Even if an instructor had an enormous laboratory capable of accommodating a large class and money to employ the best of assistants, it is also obvious that the larger the class the further removed the members must be from personal contact with their teacher, and as individuals consequently less able to benefit by his experience and by his example, these two last being perhaps after all among the most important elements of good teaching.

Assistants come not only between the head teacher and his pupils, but where there are many minds there must be some strict system and set ways of doing the work, and more or less disregard of the peculiar needs of each individual. It is, however, evident that as long as this is recognized as a necessary evil, and the red tape of the system regarded in this light and not exalted into a fetish of productive virtue, a very large class may be kept at work through assistants, if they are allowed to have some individuality themselves and are taught to cultivate the same gift in some of their pupils. In such matters, however, one must speak

from the fulness of his own experience, and I must leave this subject to those who have had experience in conducting large laboratories crowded with pupils.

My own experience has been with a few, unfortunately with very few pupils of the highest grade, and then, skipping all intermediate grades, next with pupils who have come to me uninformed or worse off in being burdened with undigested information. The first of course had almost unlimited time and ample facilities, and, therefore, do not come into consideration here.

My classes have varied from ten to five hundred, but unluckily the binding force of the conditions under which instruction was given did not vary in the same proportion. I have always been obliged to give lessons to the whole class at once, and the time has been invariably limited to comparatively few hours.

Under these somewhat difficult conditions it became necessary to adopt some system that would include, as far as practicable at least, the idea of self culture, so that the pupils would at any rate not be led into the belief that they knew how to handle and use a subject when they really had only acquired some information and the power to read about it more intelligently, and perhaps also the ability to recognize certain facts of which no educated man should be ignorant.

Permit me to exercise one of the usual privileges of every speaker and enlarge somewhat the boundaries of this discussion by asking you to consider Laboratory Teaching as but one branch of object teaching. We shall then be able to regard it from the point of view of its essential character and see more clearly its application to cases in which large classes must be dealt with in lecture rooms capacious enough to hold from eighty to five hundred or even more persons. It may then be said, that in proportion as a lecturer follows objective methods and clings to the habit of making his audience see,

each for himself or herself, the objects he is talking about, in just the same proportion is he trying, at least, to educate them according to the ideal standards.

Some twenty-four years ago the Teachers' School of Science was begun in Boston and it became necessary to decide how the lessons should be conducted. To be faithful to the ideals of science and handle a class as large as could be comfortably seated in the lecture room of the Boston Society of Natural History was the practical problem, and secondarily how to do this so as to lead to the final adoption of natural history teaching in the public schools.

Two necessary conditions were assumed as the basis of the system adopted: first, the actual study of specimens, and second, the subsequent possession of these by the teachers. This system was inaugurated with a class of eighty, and was found to be practicable with five hundred persons, and succeeded as well as could be expected with such large audiences. The lecturers employed by the school, which subsequently came for the most part under the patronage of the Trustee of the Lowell Institute, Mr. Augustus Lowell, were instructed to conform to the requirements mentioned above, and the system has not been materially altered since the beginning, except in one of these requirements. Of late years it has not been deemed necessary to have very large classes, nor to distribute specimens in such profusion as during the earlier years in which hundreds of thousands had been given away. The details are very simple. Every person in the audience is furnished with a certain number of specimens. These are placed by assistants upon temporary tables opposite each chair before the lesson begins. The tables for large classes were of the simplest description, mere boards with a slight moulding to keep objects from rolling off. They were made in sections and were fastened to the floor by iron stanch-

ions that could be unscrewed and removed after they were no longer needed. It occupied three men about one-half of a day to put them up and take them down and store them away from a lecture room accommodating five hundred persons. The seats in this room were the ordinary distance apart and were not constructed especially for the purpose of giving additional room for these tables. Similar tables have also been built and used successfully in several different lecture rooms.

The lecturer leads his hearers to observe with the specimens in hand certain facts, and he may if he chooses go far beyond these simple observations in his remarks, and he very often does this, but the specimens are dead weights upon his flights into the empyrean of fancy or theory. The objects are there; they demand constant attention, and the teacher cannot keep away from their consideration, nor can his audience lose consciousness that they are the subjects upon which the work is to be done.

The principal difficulty is to acquire the habit of carrying on the thread of the discourse, directing it to some definite morphologic point, or whatever the lecturer may choose, weaving the facts shown by the specimens into a demonstration of this point, and at the same time keep the pupils at work upon the specimens to such an extent that most of them actually see the needed facts.

The field capable of being illustrated and taught in this way is necessarily limited, and there are in each branch of science certain series of facts requiring elaborate apparatus or rare specimens that cannot be used in sufficient numbers. Nevertheless, the limits in each department are not so narrow as one at first thinks, and the field covered grows continually broader in proportion to the ability and experience of the instructor.

The first expense is not large; the cost of the Geological and Mineralogical specimens was about ten dollars for each lecture, and for Botany about fifteen, and Zoölogy twenty to twenty-five for audiences of five hundred.

But before entering upon the second part of my subject, the application of this method to smaller classes, permit me to say that diagrams were used in order to direct the attention of the audience to the facts to be observed, and they were encouraged to make notes and sketches and instructed in the use of a cheap magnifier costing from sixty to seventy-five cents. The lecturer was allowed also to place objects similar to those in the hands of the audience upon his table and platform and on the tables in the body of the lecture room, and whenever practicable these were living representatives of the preparation.

It is needless to say to this audience that no claim is made here to the discovery of a royal road to knowledge. The system itself is an ancient one and was used before I was born by many persons. The habit of observing accurately cannot be formed by an hour or two of work on Saturday afternoon, even with the use of specimens. The method has, however, a valid claim to consideration in so far as it possesses great advantages over the subjective methods of the ordinary lecture, when illustrated solely by diagrams or stereopticon pictures, and its results are far more satisfactory.

All lessons or lectures away from the actual presence of the objects described or discussed throw the individual back upon his own mental processes, unless he already has experience and knowledge of the facts treated. Illustrations in the shape of diagrams or stereopticon pictures are substitutes of one dimension; they have the superficial attributes of length and breadth, but their apparent thickness and solidity are artistic shams. People who are taught

in this way think afterwards in a weak subjective form. The objects depicted are present to them as pictures, not as things. The classes in drawing at the Lowell Institute were objectively taught and not permitted to draw from illustrations, but among the pupils there were often some that had had instruction according to this method. They were seated and placed so that no two persons got the same view of a cube mounted on a stand, in one of their lessons. Those that had had no training from copying flat illustrations tried to depict what they saw; those that had had this sort of training usually outlined the cube as they thought a cube ought to appear, giving it the conventional shape and aspect it had in their own minds. Whether seated on the floor or on chairs, or standing, in front or at one side, the cube almost invariably appeared on their sheets with the top side in perspective, whether they saw the top or did not see it from their station.

Able pupils carry away from our lessons much more than they can from lectures, however elaborately adorned with illustrations, and our results show that even the crudest efforts to observe facts with examples in hand lead often to a realization of the effectiveness of objective work and a desire for more culture in this direction.

These lectures to large audiences created gradually a demand for more precise and extensive instruction in some of our pupils, and this demand led to the giving of series of lessons on the same subjects to more limited numbers and extending over longer periods of time. These have lately taken the form of consecutive courses running through each winter for four years. We have just finished one on Geology, of this amount of time, about one hundred and thirty hours in all, and another in Botany, and have still another in Zoölogy and Paleontology, of about the same length, which will be finished this year.

In these classes numbering from thirty-six to forty-eight the lecturer treats the audience in much the same way as far as specimens are concerned, but having more time and more control over the pupils, he can do his work more effectually. Each person must have a note-book and magnifier; microscopes are furnished by the Society. The pupils are told that they must make notes, and must make sketches of the specimens. Those who state that they cannot draw are instructed to try and are shown that the quality of their drawing is not of so much importance as the employment of the eyes and mind in trying to draw the object before them. The act of trying to draw a specimen is not absolutely essential to the success of this method, but it is very helpful. It holds the pupil down to his work, keeps him constantly observing, and he soon learns to make approximately a good outline of the specimen, and then studies the details much more closely than he would otherwise do, if not making an effort to represent them on his sketch.

Different teachers have different ways of doing their work, but in general it may be said that those at present at work in the school follow this process more or less and also hold either examinations at stated intervals or have reviews in which the students are questioned with regard to what they have been studying and so on. One gentleman keeps a complete card catalogue of names and marks, so that he can follow accurately the exact course of each pupil back through the entire four years, and he holds no final examination, preferring to make his work perfect as he goes along.

Two of the teachers—there are only four in all—have constantly had the services of two assistants who helped to set out the specimens and clear the tables after the lessons were finished. These assistants were for the most part selected from the audience, and can generally be obtained in this way,

either as voluntary laborers or for a very moderate compensation. These persons, under the direction of the teacher, help him to supervise the note making and microscopical observations of the pupils and help them to see and discuss with them the facts that they observe. A large part of every lesson is passed in the description and discussion of observations made on the specimens. The pupils are also encouraged to work independently in making connected studies and collections out of doors, and to embody the results in reports and actual collections presented at the final examinations or at the close of the term.

Field work is also carried on in connection with the laboratory lectures in mineralogy and geology, and it is proposed to do the same when opportunity offers in other branches. One can judge in part of the ability and attainments of classes by the examination papers and their note-books kept through the term, and the results in this direction have been highly satisfactory. I have not had time to gather any of these evidences as I had intended to do, and I shall have to ask you to take my word for it that these were more than creditable. I have brought a few placards of the courses and of the questions for the final examinations in two of the courses, which I have exhibited for your inspection.

The persons attending these lessons were all adults and mostly teachers in the public schools, but the same method has been found to be equally successful with classes of the Institution of Technology and Boston University, and no difficulty has been experienced in handling them in this way beyond what is usual with such pupils. Pupils of the Teachers' School of Science have also applied the same method to large classes of young people of both sexes in the public schools, and by covering less ground at each lesson succeeded with them also.

In certain subjects, such as Physical Geog-

raphy, Chemistry and Physics, and Physiology, and so on, this method has a necessarily more limited application than in the branches enumerated above, but even in these departments it has been more or less used, directly by selecting the few experiments that could be actually made by individuals in the audience, and indirectly by showing others on the platform that could be repeated by them with apparatus that they could make themselves, or purchase with very small outlay.

Permit me in conclusion to repeat that it has been thoroughly tested with such classes of persons of all ages as have been described, but it has not yet, as far as I know, been applied to large classes of students in any university. If it has been applied to such classes by any one their experience is probably known to some persons in the audience, and I shall be glad to hear what the results have been. I am aware that our experience will probably be of real value only to those who have to deal with classes having at their command a limited number of hours and but little chance for laboratory work outside of the hours devoted to the lessons. Nevertheless, there are many who now lecture with illustrations, diagrams and the stereopticon, to whom I would with all deference suggest the possibility of adding to these specimens distributed among their pupils. And I further make bold to recommend that those who make partial use of text-books, as aids for the pupils to study and recite from, drop a part of these requirements and allow their pupils to substitute actual work on specimens done inside or outside of the class-room, collections made by themselves and so on. I also crave their permission to suggest one feature of our examinations which you will see mentioned on the cards I have displayed. This consists in placing before each pupil a set of test specimens which he is required to place in proper sequence as regards their

mutual relations, to number, name, describe, and so on, in accordance with what he has been taught. I have myself a way of slipping into this set one object that the pupils have never seen, so far as I know their studies. The replies to this silent questioner frequently enable me to determine who are the best observers and most original thinkers, and very often point out clearly the difference between them and those who are merely the best students.

Whether this system is the best that can be devised or has only some praiseworthy feature, or is in reality but a poor substitute for a good one, I shall not pretend to decide. There are numbers of scientific teachers of great experience and learning present who have heard my arguments and must be our judges, but I think they will all indulgently agree that the teachers who have adopted and elaborated this method have tried to come as near to the ideals of objective work as the adverse circumstances of large classes and limited time would permit.

ALPHEUS HYATT.

BOSTON.

ORIGINAL RESEARCH AND CREATIVE AUTHORSHIP THE ESSENCE OF UNIVERSITY TEACHING.*

THAT which is most characteristic of the present epoch in the history of man is undoubtedly the vast and beneficent growth of science. In things apart from science, other races at times long past may be compared to the most civilized people of to-day.

The lyric poetry of Sappho has never been equalled. The epic flavor of Homer, even after translation, comes down to us unsurpassed through the ages. Dante, the voice of six silent centuries, may wait six centuries more before his mediæval miracle of song finds its peer.

* Inaugural Address by the President of the Texas Academy of Science, Dr. George Bruce Halsted, October 12, 1894.

The Apollo Belvidere, the Venus of Milo, the Laocoön are the glory of antique, the despair of modern sculpture. To mention oratory to a schoolboy is to recall Demosthenes and Cicero, even if he has never pictured Cæsar, that greatest of the sons of men, quelling the mutinous soldiery by his first word, or with outstretched arm, in Egypt's palace window, holding enthralled his raging enemies, gaining precious moments, *time*, the only thing he needed to enable him to crush them under his dominant intellect.

There is no need for multiplying examples. The one thing that gives the present generation its predominance is science. The foremost factor in modern life is science. All criticisms of the scope of life, of the essence of education, made before science had taken its present place, or attempting to ignore its prominence, are obsolete, as are of necessity any systems of education founded on pre-scientific or anti-scientific conceptions.

Unfortunately there are still some people so dull, so envious, so unscientific, so stupid as to maintain that the highest aim of a university should be the *training* of young men and young women, where they use the word 'training' in its repressive, inhibitive sense. The most profound discoveries of modern science unite in replacing this old 'training' idea of education by one immeasurably higher, finer, nobler. We now know that the paramount aim of teaching at every stage, and preëminently of the final stage, at the university, should be to *help* the developing mind, the developing character, the developing personality. Judicious, delicate, sympathetic *help* is now the watchword. Even horses and dogs worth owning are no longer 'broken;' they are 'gentled.'

What has brought about this glorious change? *Science*, the greatest achievement of human life, the one thing that puts to-

day, the present, in advance of all past ages. Not only by having subjugated the forces of nature to the dominion of mind, but also by its intellectual influence, science is remodelling the life and thought of modern humanity.

Though science is the purest knowledge, yet even our estimate of knowledge has been changed by science. Mere acquirement is now considered an unworthy end or aim for endeavor. Action, production alone now receives our homage, now gives a life worth living; and, therefore, each must aim either at the practical application of his knowledge, or at the extension of the limits of science itself. For to extend the limits of science is really to work for the progress of humanity. This is a fitting crown to the sweet and symmetrical evolution which true teaching aids—the unfailing spring of pure pleasure which it affords. The laws of physical, but, above all, of mental health, made clear by science, let every one realize how now our truest education stands ready to aid, to save, to satisfy endangered or craving bodies or minds. Nothing is more beautifully characteristic of young children than the desire to know the why and wherefore of everything they see. This natural spirit of inquiry needs only proper direction and fostering care to give us scientists. But no one can teach science who does not know it. For a teacher, however subordinate, to have the true informing spirit to vivify his book-knowledge, even of the very elements, it is found almost uniformly essential that he should have been in direct personal contact with some one of those great men whose joy it is to be able to advance the age in which they live, and lead on mankind to unexpected victories in the progressive conquest of the universe. But it is the highest function of a university to help the gifted young man on his way toward becoming one of these glorious creators, these men

who make and who honor the age in which they live. A university should wish to feed the mental leaders of the next generation. For this nothing can take the place of contact with the living spirit of research, original work, creative authorship.

Without fostering and requiring such work of students and still more of all its professors, no institution can be a university of the first class. Intimate contact with a producer of the first rank is worth more than the whole world of so-called training by use of retailed convictions.

The most inspiring teacher must have known how to acquire conviction where no predecessor had ever been before him; to show others how to conquer new regions, he must himself have broken barriers for human thought. As Rector of the University of Berlin, Helmholtz said: "Our object is to have instruction given only by teachers who have proved their own power to advance science." There is no honest test or proof of scholarship or acquirement but production. The characteristic quality of all the highest teaching lies in the fact that it comes from a creator.

No more convincing demonstration of my thesis could be wished for than the work of Sylvester for America. On page 233, I., of his *Höhere Geometrie*, 1893, Felix Klein, as high an authority as any living, says: "Sylvester hat noch 1874 als 60 jähriger Mann den Mut gehabt an die Johns Hopkins University in Baltimore ueberzusiedeln und durch eine ganz spezifische durch 10 Jahre fortgesetzte Lehrthätigkeit höhere mathematische Studien auf amerikanischen Boden zu initiiren."

The birth of higher mathematics in America will always date from Sylvester's advent at the Johns Hopkins. There and then with his mighty head he raised the whole western continent, and made it a worthy associate in the profoundest thought-life of our world. But few know that this

epoch-making period was not Sylvester's first advent in the United States. The immortal glory now belonging to the Johns Hopkins University might have been anticipated by another, and with the very same instrument.

An adequate life of James Joseph Sylvester has never been written, and probably never will be while he lives. At Cambridge he was most impressed by a classmate of his own, the celebrated George Green, who had already then produced the remarkable Green's Theorem, and much of the work which still stands as a foundation stone in the edifice of modern electrical science. As Sylvester would not sign the thirty-nine articles of the Established Church, he was not allowed to take his degree, nor to stand for a fellowship, to which his rank in the tripos entitled him.

Sylvester always felt bitterly this religious disbarment. His denunciation of the narrowness, bigotry, and intense selfishness exhibited in these creed tests was a wonderful piece of oratory in his celebrated address at the Johns Hopkins University. No one who saw will ever forget the emotion and astonishment exhibited by James Russell Lowell while listening to this unexpected climax. Thus barred from Cambridge, he accepted a call to America from the University of Virginia.

The cause of his sudden abandonment of the University of Virginia is often related by the Rev. Dr. R. L. Dabney, as follows: In Sylvester's class were a pair of brothers, stupid and excruciatingly pompous. When Sylvester pointed out one day the blunders made in a recitation by the younger of the pair, this individual felt his honor and family pride aggrieved, and sent word to Professor Sylvester that he must apologize or be chastised.

Sylvester bought a sword-cane, which he was carrying when waylaid by the brothers, the younger armed with a heavy bludgeon.

An intimate friend of Dr. Dabney's happened to be approaching at the moment of the encounter. The younger brother stepped up in front of Professor Sylvester and demanded an instant and humble apology.

Almost immediately he struck at Sylvester, knocking off his hat, and then delivered with his heavy bludgeon a crushing blow directly upon Sylvester's bare head.

Sylvester drew his sword-cane and lunged straight at him, striking him just over the heart. With a despairing howl, the student fell back into his brother's arms screaming out, "I am killed!" "He has killed me." Sylvester was urged away from the spot by Dr. Dabney's friend, and without even waiting to collect his books, he left for New York, and took ship back to England.

Meantime a surgeon was summoned to the student, who was lividly pale, bathed in cold sweat, in complete collapse, seemingly dying, whispering his last prayers. The surgeon tore open his vest, cut open his shirt, and at once declared him not in the least injured. The fine point of the sword-cane had struck a rib fair, and caught against it, not penetrating.

When assured that the wound was not much more than a mosquito-bite, the dying man arose, adjusted his shirt, buttoned his vest, and walked off, though still trembling from the nervous shock. Sylvester was made head professor of mathematics of the Royal Military Academy at Woolwich, a position which he held until the early period set by the English military laws for conferring the life-pension.

He thus happened to be free to accept a position at the head of mathematics in the Johns Hopkins University at its organization. With British conservatism, he stipulated that his traveling expenses and annual salary of five thousand dollars should be paid him in gold, and this fixed, he came a second time to America.

The fame of his coming preceded him, for

by this time he was ranked by Kelland in the *Encyclopædia Britannica* as the very foremost living English mathematician. The only possible sharer of this proud preëminence was his life-long friend Cayley.

Appointed among the first twenty fellows at the organization of the Johns Hopkins University, and having an intense desire to study Sylvester's own creations with him, I became alone his first class in the new University. Sylvester gives in his celebrated address a graphic account of the formation of that first class as illustrating the mutual stimulus of student and professor.

The text-book was Salmon's *Modern Higher Algebra*, dedicated to Sylvester and Cayley as made up chiefly from their original work.

The professor broke every rule and canon of the Normal Schools and Pedagogy, yet was the most inspiring teacher conceivable. Every thing, from music to Hegel's metaphysics, linked into the theory of Invariants, combined with the precious personal data, and charming unpublished reminiscences of all the great mathematicians of the preceding generation.

Such a course in the creation of modern mathematics, with most precious, elsewhere unattainable, historic indications, will perhaps never be paralleled. It went on not only at the appointed hours, but the professor would send for his class at night, while at other times they took excursions together to Washington. The incidents of these two formative years, spent in most intimate association with one of the great historic personages of science, can never be forgotten. It was during this period that Sylvester founded the *American Journal of Mathematics*, and it is due to his particular wish that it was given the quarto form.

Then began a new productive period in his life, the astounding activity and marvelous results of which can be faintly esti-

mated by consulting the pages upon pages taken up in the *Johns Hopkins Bibliographia Mathematica*, merely to enunciate the titles of the memoirs and papers produced. The very complete and profound historic and bibliographic account of the theory of Invariants given by Meyer in the *Berichte of the deutsche mathematische Gesellschaft* indicates very fairly Sylvester's final place in the history of that all-pervading subject. His original contributions to many other parts of the vast structure of modern pure analysis are of nearly as great weight.

Sylvester was completely of the opinion that no teaching for a real university can be ranked high which is not vitalized by abundant original creative work. He maintained that it was the plain duty of any mature man holding a professorship in a real university to resign at once if he had not already been copiously and creatively productive.

He believed that without unceasing original research and published original work there could be no real university teaching, and that any university professor who, without such a basis, pretended to be a good teacher, was, consciously or unconsciously, a selfish fraud.

On page 6 of his address delivered on Commemoration Day, 1877; he speaks of a university 'under its twofold aspect as a teaching body and as a corporation for the advancement of science.' He then continues; "I hesitate not to say that, in my opinion, the two functions of teaching and working in science should never be divorced.

"I believe that none are so well fitted to impart knowledge as those who are engaged in reviewing its methods and extending its boundaries . . . May the time never come when the two offices of teaching and researching shall be sundered in this University!"

This was spoken of the Johns Hopkins. Since then no university has voluntarily avowed an ideal not equally noble and exalted. Science, penetrating ever deeper, makes clear the conditions of progress, of true education, of finest teaching.

Only those who have produced can adequately fulfill its present motto: "I serve, I help."

GEORGE BRUCE HALSTED.

UNIVERSITY OF TEXAS.

THE ARCHAEOLOGY OF SOUTHERN FLORIDA

THROUGH the investigations of Professor Jeffries Wyman, Mr. A. E. Douglass and lately of Mr. Clarence B. Moore, a large amount of accurate information about the mounds of central and southern Florida has been laid before the public. Especially noteworthy are Mr. Moore's explorations, which have been published with every desirable addition of maps, measurements and illustrations. They were conducted with a fidelity to the correct principles of mound excavation, which renders them models of their kind. The results were rich, instructive, often surprising, such as copper breast-plates and ornaments, curiously decorated pottery, specimens of Catlinite, and little earthen images, very life-like, of the bear, squirrel, wildcat, and even the tapir, which latter had become extinct in Florida when the whites first explored it.

Nothing, however, which has been found in the mounds of Florida justify us in separating them as a class from other mounds in the Southern States; there is nothing in them 'extra-Indian,' as Mr. H. C. Mercer remarks in his review of the subject in the *American Naturalist* for January. He might have gone further and have said there is nothing extra-North American Indian. The pottery decoration does not reveal those arabesque designs which Mr. Holmes has pointed out in some of the more modern pottery of the Gulf coast, as indicating Caribbean or Antillean influence. If that

arrived, its arrival was later than the construction of the older Floridian mounds.

But an obscurity certainly hangs over the ethnography of Florida at the period of the discovery.

A large part of the peninsula was peopled by a tribe whose language stood alone on the continent, the Timucuas, and which became extinct generations ago, though fortunately reserved in the works of a Spanish missionary, Father Pareja. They are described by the Spanish and French explorers of the sixteenth century as quite a cultured people, and at that time building mounds and erecting their houses upon them.

It is not certain that they extended to the extreme south, and therefore this portion of the peninsula is left blank on the linguistic map of the region. That some tribe of advanced culture occupied the territory about the Carlosahatchie bay is revealed by a curious discovery due to the distinguished antiquary and explorer M. Alphonse Pinart, which he communicated to the former publisher of SCIENCE. In examining a rare work by Father Francisco Romero, published at Milan in 1693, entitled *Llanto Sagrado de la America Meridional que busca alivio en los reales ojos de Nuestro Señor Don Carlos III.*, he found the statement that a chieftain called Carlos, who lived on the bay of that name on the southwest coast of Florida, came across to Havana in a small canoe to be instructed in the Christian faith and baptized. On returning, the authorities promised to send a missionary to his people, but neglected to fulfill their agreement.

"Some time afterward," says the writer, "they received a letter written with characters entirely different from ours, and with a strange ink. This letter was brought across by a fisherman, who translated it. He stated that the Floridian chief, Carlos, sent by it his respectful homage to the authorities, and complained bitterly that the missionary had not been sent to him."

The original, says the author, was subsequently taken to Spain and deposited in the library of the Duchess of Aveyro. M. Pinart adds that, from correspondence with the representatives of that family; he has reason to believe this original is still in existence.

Whether the 'writing' was the familiar pictography of the North American Indian, or allied to that higher form which prevailed in Mexico and Yucatan, may be decided by a sight of the document itself. At any rate, it is worth mentioning that this unknown people had a recognized system of recording ideas; and possibly investigations in the mounds of that locality may bring other specimens to light.

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THE EARLIEST GENERIC NAME OF AN AMERICAN DEER.

IN September, 1817, Rafinesque published descriptions of two species of deer from Paraguay, which he named *Mazama bira* and *M. pita*.* The first was based on the *Gouazoubira*, the second on the *Gouazoupita*, of Azara. Both had been previously described by Illiger†; consequently the specific names fall. *Mazama bira* Raf. = *Cervus rufus* Ill.; *M. pita* Raf. = *C. simplicicornis* Ill. But the generic name *Mazama* antedates by many years the names *Subulo* ‡, *Passalites* §, *Coassus* ||, and even *Cariacus* ¶, and hence is the earliest generic name for any American deer, so far as known. Fortunately, the rules

*Am. Monthly Mag., Vol. I., No. 5, Sept. 1817, p. 363.

†Abhandl. K. Preuss. Akad. Wiss., Berlin (for 1811), 1815, p. 117.

‡*Subulo* H. Smith, Griffith's Cuvier, Vol. V., 1827, p. 318.

§*Passalites* Gloger, Hand- u. Hilfsbuch Naturgeschichte, 1, 1841, p. 140.

||*Coassus* J. E. Gray, List. Mamm. British. Mus., 1843, pp. xxvii and 174.

¶*Cariacus* Lesson, Nouv. Tableau Regne Animal, Mammif., 1842, p. 173.

of nomenclature demand that the type be chosen from the species originally covered by the genus; it cannot be taken from those subsequently added by Rafinesque himself (in Am. Monthly Mag., Vol. I., p. 437, Oct. 1817; and Vol. II., p. 44, Nov. 1817). The type therefore must be one or the other of the two well known South American deer, *rufus* or *simplicicornis*, and may be restricted to the form, which will stand as *Mazama rufa* (Illiger).

C. HART MERRIAM.

JAMES OWEN DORSEY.

REV. J. OWEN DORSEY, Indian linguist, died in Washington, February 4, of typhoid fever. For over twenty years Mr. Dorsey was an enthusiastic student of aboriginal languages, chiefly those of the Siouan family. His acquaintance with these languages was so extended and his grasp of principles so strong as to render him one of the foremost authorities on Indian linguistics. Although numerous publications have been made under his name, the greater part of the material collected and created during his active career remains unpublished. Fortunately, this rich store of manuscripts is preserved, under the systematic arrangement of their author, in the Bureau of American Ethnology, with which Mr. Dorsey has been connected from its organization.

James Owen Dorsey was born in Baltimore, Maryland, October 31, 1848, and received his earlier education in local schools. He was remarkably precocious, reading Hebrew at the age of ten, and his vocal range and power of discriminating and imitating vocal sounds were exceptional. He entered the Theological Seminary of Virginia in 1867, was ordained a deacon of the Protestant Episcopal Church in 1871, and during the same year became missionary among the Poncha Indians, in what was then Dakota Territory. There he began systematic study of Indian language, myth and custom.

Among his publications are memoirs on 'Omaha Sociology,' 'Osage Traditions,' 'a study of Siouan cults,' 'Omaha dwellings, furniture and implements,' printed in the annual reports of the Bureau of American Ethnology; 'Omaha and Ponca letters,' a bulletin of the same bureau; and the 'Dhegiha language,' forming Volume VI. of the Contributions to North American Ethnology. In addition he edited a Dakota-English dictionary, and a volume on Dakota grammar, texts and ethnography, by the late Rev. S. R. Riggs, published in two volumes of the last named series. Numerous minor articles were published in different anthropologic journals. Mr. Dorsey was Vice-President of Section H of the A. A. A. S. in 1893, and at the time of his death was Vice-President of the American Folklore Society. In the absence of the President of this Society he presided over the annual meeting in Washington during the Christmas holidays, this being his last public work in science.

W J M

DISCUSSION.

ON INDISCRIMINATE 'TAKING.'

IN many of the text-books which have of late appeared, and even in articles by some of the most renowned chemists, the verb 'to take' is frequently used in a way that is very annoying to teachers who are endeavoring to train students in brevity and exactness of expression. Pages could be filled with examples of bad style and verbosity that ill-accord with the clearness and brevity that are desirable, and that are supposed to characterize scientific literature. A few quotations from recent text-books will suffice to illustrate this particular case—that of indiscriminate 'taking.'

"Take a cylindrical porous jar, such as is used in a galvanic battery, close the open end, etc."

It were better to say, "close the end of a cylindrical porous jar, such as is used, etc."

Another example: "Take two flasks and connect them."

Better—"Connect two flasks," etc.

Another: "The method of experimenting adopted by Graham was to take a bottle or jar with a neck contracted somewhat and fill it to within half an inch of the top with the solution of the salt to be investigated."

Better—"The method . . . was to fill a bottle or jar with a somewhat contracted neck to within half an inch," etc.

Another: "If we take an iron tube closed at one end and connected at the other with a Sprengel pump and exhaust it completely."

This awkward form of diction often excites mirth in the class-room, as it gives unusual opportunities for double meanings.

"Take a pound of sugar and an equal weight of sulfuric acid." This would be a severe dose, even for a trained scientist.

The following is from a recent text-book: "Take a lump of chalk or sandstone, some very dry sand, a glass of water and a glass of treacle."

This might do for a bill of fare in a Chinese restaurant, but it is out of place in a scientific book.

"Take some white arsenic."—"Take a sedlitz powder,"—are the singular directions which preface two experiments in a book recently published by the Society for Promotion of Christian Knowledge in London.

If editors and teachers will pay more attention to this awkward use of the word 'take' they will incur the gratitude of a patiently suffering public.

PETER T. AUSTEN.

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SCIENTIFIC LITERATURE.

The Life of Richard Owen. By his grandson, the REV. RICHARD OWEN, M. A. With the scientific portions revised by C. DAVIES SHERBORN. Also an essay on Owen's position in anatomical science.

By the RIGHT HON. T. H. HUXLEY, F. R. S. Portraits and illustrations. In two volumes. New York, D. Appleton & Co. 1894. Pp. 409, 393. \$7.50.

The life of the great English comparative anatomist as told in these volumes was in many respects an ideal one. It is the old story of a self-made man, who, without the advantages of good preparatory schools, or of the university life at Cambridge or Oxford, by his own native ability and industry, as well as by his kindly disposition and social tact, rose to the highest scientific position in Great Britain, came to be the friend of some of England's leading statesmen, of her greatest poets and novelists; the recipient of marked favors from the Queen; living to see the completion of the magnificent natural history museum at South Kensington planned by himself, and dying at the great age of eighty-eight years, during sixty of which he published the long series of monographs and general works which form his most enduring monument.

This biography, as prepared by his grandson largely from Owen's letters and diary and those of his wife, even if it includes what may be thought to be many trivial details, gives what seems to us to be a most attractive and life-like sketch of the man. We see Owen, not only in his study at the College of Surgeons and afterwards at the British Museum, but also at his home in the little rambling thatched cottage in Richmond Park, presented him by the Queen. We also catch glimpses of his club life, of his success as an administrator, as a lecturer, as a literateur; we are given evidences of his fondness for art and music and the drama, as well as poetry, and accounts of his journeys over the continent and up the Nile.

It is a record not of a scientific recluse, but of one who had many outside interests, and who lived in touch with the best minds and the best thought of his time.

Richard Owen was born in 1804 at Lancaster, the son of a merchant. After leaving the grammar school, he was when sixteen apprenticed to a surgeon, and when twenty matriculated at Edinburgh University as a medical student. Six years after he became prosecutor to Dr. Abernethy in London and assistant curator of the Hunterian Collection at the College of Surgeons, and in 1856 was appointed superintendent of the Natural History collections of the British Museum, a position created for him and which he held until shortly before his death.

His first paper was published in 1830, and two years later his famous memoir on the pearly nautilus. This at once gave him a national and continental reputation as a comparative anatomist of the first rank. Huxley makes the generous claim, in referring to the work, that there is nothing better in Cuvier's '*Mémoires sur les Mollusques*,' and he adds: "Certainly in the sixty years that have elapsed since the publication of this remarkable monograph, it has not been excelled, and that is a good deal to say with Müller's '*Myxinoid Fishes*' for a competitor." Owen's last work (the list of the entire series of articles, monographs and general works embracing 647 titles) appeared in 1889. What a record! Sixty years of almost uninterrupted health, of unexampled productiveness, of accurate, painstaking, honest labor.

Owen's place in biological science, a science which has widened and deepened so immeasurably since the date of publication of his first great work in 1832, is not altogether easy to determine, but the task is much lightened by the appreciative and magnanimous essay by Professor Huxley on Owen's position in Anatomical Science, placed at the end of the biography.

Owen was called by some of his contemporaries 'the British Cuvier,' and this fairly well expresses his position. He may be said to have lived in the interregnum between

the age of Oken, St. Hilaire and Cuvier, and the age of the modern school of morphologists. He made no special contributions to comparative embryology; he was guiltless of histology and of microscopic technique. His ideas and lines of thought and work were a fusion of Okenism and of the doctrine of correlation of organs taught by Cuvier, with perhaps a slight infusion of the transformationist school of France. Like some of the fossil forms which he restored with masterly skill and philosophic insight, he was in a sense a synthetic or prophetic type of naturalist. For example, he declined when asked to attack the 'Vestiges of Creation', rather sympathizing with the views put forth in that book; but also objected to become a loyal disciple of his friend, Darwin. He partially accepted the general doctrine of evolution; but though his views were vague and unformed, like many others perhaps in the period between 1850 and 1870, he probably felt that Natural Selection was not a sole, efficient cause, though believing in the orderly evolution of life by secondary law.

We find in this life no statement from Owen's own letters or journals regarding his attitude to the doctrine of natural selection. Either he was late in life somewhat indifferent, or he was guarded in speaking or writing of the matter. Certainly there are no grounds for the statement sometimes made that he showed outright 'hostility' to Darwinism, unless his *Athenæum* article be regarded as such. In Owen's evidence before Mr. Gregory's committee regarding the removal of the Natural History Collection to South Kensington his biographer tells us: "Owen made some interesting remarks concerning Darwin's work on the 'Origin of Species,' just published, which helps to strengthen the impression that he was at first much taken with the new views, and felt the same friendliness toward them as he had previously shown to the views expressed in

the 'Vestiges of Creation.' " Owen remarks concerning the arrangement of the new museum: "With regard to birds, I must say that not only would I exhibit every species, but I see clearly, in the present plan of natural history philosophy, that we shall be compelled to exhibit varieties also. . . . As to showing you the varieties of those species, or any of those phenomena that would aid one in getting at the mystery of mysteries, the origin of species, our space does not permit;" and again he replies to a question of the chairman: "I must say that the number of intellectual individuals interested in the great question which is mooted in Mr. Darwin's book is far beyond the small class expressly concerned in scientific research."

Owen's controversial papers, as well as his statements of scientific belief, were at times vague and a grain oracular, and were presented in a labored style, quite different from that of his letters and popular lectures, or even his work on Archetypes, the style of which has been characterized as 'clear and forcible.' Darwin in the well known reference to Owen's views in the *Historical Sketch* prefacing the sixth edition of the *Origin of Species* was, he says, 'completely deceived' by such expressions as 'the continuous operation of creative power,' and he was apparently unable to determine what his real opinions were, and was evidently piqued and disappointed that the great anatomist, his old scientific friend of many years, did not accept the doctrine of natural selection. On p. 91 his biographer states: "If not 'dead against' the theory of natural selection, Owen at first looked askance at it, preferring the idea of the great scheme of Nature which he had himself advanced. He was of the opinion that the operation of external influences and the resulting 'contest of existence' lead to certain species becoming extinct. Thus it came about, he supposed, that, like the dodo in recent times,

the *dinornis* and other gigantic birds had disappeared. But he never, so far as can be ascertained, expressed a definite opinion on Darwinism."

It is well enough at this day, when the scientific world is of one mind as regards the truth of the evolution theory, to ascribe indifference and even 'hostility' to Owen, but we fail to see that this is quite just. For Owen, so far from attacking or minimizing the new plan of evolution invoked by Darwin, was even said by the editor of the '*London Review*,' as Darwin tells us, in his own words, to have 'promulgated the theory of natural selection before I had done so.'

So strong a Darwinian as the acute and clear-headed Gray states, more fully and satisfactorily perhaps than Darwin, the position of Owen. In his '*Darwiniana*' Dr. Asa Gray, who, writing in 1860, frankly confesses: "We are not disposed nor prepared to take sides for or against the new hypothesis," and yet who by his own studies and mental tendencies was 'not wholly unprepared for it,' thus humorously refers to Owen's views, published before the appearance of Darwin's book, "Now and then we encountered a sentence, like Prof. Owen's 'axiom of the continuous operation of the ordained becoming of living things,' which haunted us like an apparition. For, dim as our conception must needs be as to what such oracular and grandiloquent phrases might really mean, we feel confident that they presaged no good to old beliefs" (p. 88). Further on he writes: "Owen himself is apparently in travail with some transmutation theory of his own conceiving, which may yet see the light, although Darwin's came first to the birth. . . . Indeed to turn the point of a pungent simile directed against Darwin—the difference between the Darwinian and the Owenian hypotheses may, after all, be only that between homœopathic and heroic doses of the same drug" (p. 102). Again, in 1873, he writes:

"Owen still earlier signified his adhesion to the doctrine of derivation in some form, but apparently upon general, speculative grounds; for he repudiated natural selection, and offered no other natural solution of the mystery of the orderly incoming of cognate forms."

Finally we may quote from a letter of Darwin's (*Life* ii. p. 388), written in 1862 to Sir Charles Lyell: "I was assured that Owen in his lectures this spring advanced as a new idea that wingless birds had lost their wings by disuse, also that magpies stole spoons, &c., from a remnant of some instinct like that of the Bower bird, which ornaments its playing passage with pretty feathers. Indeed, I am told that he hinted plainly that all birds are descended from one."

From all that has been said it would seem to follow, from a perusal of these scattered fragments, that Owen was an evolutionist somewhat of the Lamareckian school; that he was not a Darwinian as such, not being fully persuaded of the adequacy of natural selection as the sole cause of all evolution. To this class certainly belong some naturalists and philosophers of the present day. But it should be added that Owen, in the latter part of his life, did not use the hypothesis or theory as a working one, as did some of the elder naturalists of his own period, as Lyell, Wyman, Leidy, etc. He was fifty-five years old when the '*Origin of Species*' appeared, and either was not then prone to speculation, or had little leisure for it.

It must be granted that Owen, clear-headed and sagacious as he was, did not rise to the plane of that high quality of genius which opens up new lines of investigation. His was not an epoch-making mind of the quality of Lamareck or Darwin, in the field of evolution, nor of Müller, Von Baer, Rathke, and Huxley, the founders of modern morphology; nor of Koelliker or

Leydig, the founders of modern histology. He was a closet naturalist, made no collections with his own hands, was not a field paleontologist; and his travels were rather for health and recreation than for study or exploration. The vast collections which poured in upon him from South America, Australia and New Zealand, as well as from his own land, occupied his working hours and energies decade after decade, until the passing years left him stranded on the shores of a world of ideas and modes of cooking now subsiding beneath the incoming flood of modern methods and theories.

And yet, his philosophic grasp and suggestive mind exhibited in his treatment of the subject of parthenogenesis, in his essay on the subject which appeared in 1849, and in which he has, as Huxley states, anticipated the theory of germ-plasm of Weismann, are qualities of genius, and prove what he might have produced, had he received any training along the lines of embryology and cell-doctrines.

"Owen, in fact," says Huxley, "got no further towards the solution of this wonderful and difficult problem than Morren and others had done before him. But it is an interesting circumstance that the leading idea of 'Parthenogenesis,' namely, that sexless proliferation is, in some way, dependent upon the presence in the proliferating region, of relatively unaltered descendants of the primary impregnated embryo cell ($A + B$) is at the bottom of most of the attempts which have recently been made to deal with the question. The theory of the continuity of germ-plasm of Weismann, for example, is practically the same as Owen's, if we omit from the latter the notion that the endowment with 'spermatic force' is the indispensable condition of proliferation."

Owen's greatest works, those of most lasting value, in vertebrate zoölogy were, as pointed out by Huxley, besides his memoir on the anatomy of *Nautilus*, his work on

Odontography, his papers on the anthropoid apes, on the aye-aye, on Monotremes, and on Marsupials, as well as on Apteryx, the great auk, the Dodo, and *Dinornis*, as well as *Lepidosiren*, while chief among his essays on fossil mammals were those on *Mylodon*, *Megatherium*, *Glyptodon*, etc. He also proposed the orders of Theriodonta (*Anomodontia*), Dinosauria, and Pterosauria, and as early as 1839, as Zittel states, "he began his long series of fundamental works which continued to appear for half a century, and which laid the foundation for all later researches on fossil reptiles." He also revised the classification of the Ungulates, his divisions of odd and even-toed Ungulates being well founded and generally accepted.

Unlike Cuvier and others, Owen labored without the aid of trained assistants; he did his own work unassisted. And here arises the question how far he was indebted to Cuvier for his methods of work. It is generally supposed and stated that Owen studied in Paris under Cuvier, and that "Cuvier and his collections made a great impression on Owen, and gave a direction to his after studies of fossil remains." But his biographer explicitly states that he only made a brief visit to Cuvier in July, 1831, and gives us the following account of his intercourse with the great French anatomist: "His rough diary, which he kept during his stay at Paris, seldom mentions the fossil vertebrate collection, and shows that his interviews with Baron Cuvier were for the most part of a purely social character. It notes, for example, that he attended pretty regularly Cuvier's soirées, held on Saturday evenings, and that he enjoyed the music. With the diary agree his letters. Both devote page after page to the sights and amusements of Paris. Owen, in fact, seems to have regarded this stay at Paris as an exceedingly pleasant and entertaining holiday. At the same time it is impossible to form a just estimate of Owen's work without tak-

ing the labors of Cuvier into account. Although Owen stands on ground wholly his own, he was ever willing to acknowledge the debt which he owed to Cuvier."

The name of Owen will ever be associated with those of Oken, Goethe, Spix, and Carus, or the school of transcendental anatomy. The discussion by Huxley of Owen's work on the archetype of the vertebrate skeleton is handled in his peculiarly trenchant and clear-minded way, and yet his criticisms are genial, just and broad. It should be remembered that Owen's work 'On the Archetype and Homologies of the Vertebrate Skeleton' appeared in 1848, over ten years before the appearance of the 'Origin of Species,' and at a period when many minds in the scientific world were tinged more or less deeply with the spirit of the German and French transcendental school of anatomy. As Huxley eloquently expresses it, "The ablest of us is a child of his time, profiting by one set of its influences, limited by another. It was Owen's limitation that he occupied himself with speculations about the 'Archetype' some time before the work of the embryologists began to be appreciated in this country. It had not yet come to be understood that, after the publication of the investigations of Rathke, Reichert, Remak, Vogt and others, the *venue* of the great cause of the morphology of the skeleton was removed from the court of comparative anatomy to that of embryology." He then adds: "It would be a great mistake, however, to conclude that Owen's labours in the field of morphology were lost, because they have yielded little fruit of the kind he looked for. On the contrary, they not only did a great deal of good by awakening attention to the higher problems of morphology in this country; but they were of much service in clarifying and improving anatomical nomenclature, especially in respect of the vertebral region."

As regards the vertebrate theory of the

skull, perhaps the last word has not been said, if traces of vertebræ still, as is alleged, appear in certain of the sharks.

If Huxley by his destructive criticism has destroyed, or seemed to have destroyed this theory, the ghost is apparently not wholly laid. The more ideal constructive, German minds, as Gegenbaur and others, claim that the adult skull is in a degree segmented, as evinced by the serial arrangement of the nerves, as well as of the branchial arches. Though Wiedersheim states* that "the attempt to explain the adult skull as a series of vertebræ fails completely," adding, "it is a case of protovertebræ only," he says in a foot-note that Rosenberg has, however, shown that in a shark (*Carcharias glaucus*), "the portion of the cranium lying between the exit of the vagus and the vertebral column is clearly composed of three vertebræ." Gadow finds four vertebræ in embryos of *Carcharias*, while Sagemehl has found a somewhat similar modification in Ganoids. It would seem that the segmentation of the head observed in the embryo of vertebrates, and probably inherited from their vermician ancestors, has been obliterated in the adults by adaptation, but that traces may have survived in certain sharks and Ganoids.

Finally, it must be conceded that though it is the fashion of the younger men to characterize Owen as a comparative anatomist of the old school, and now quite overshadowed by the scientific leaders of the present generation, the kindly and discriminating judgment of the great English anatomist and essayist we have just quoted, will undoubtedly be sustained by many coming generations. Owen's place in natural science, in many respects an unique one, will be among the greatest anatomists of the first half of our century. His name will bridge over the gap between Cuvier, and the embryologists and morphologists

*Elements of the Comparative Anatomy of Vertebrates, p. 56.

of the second half of the nineteenth century.

A. S. PACKARD.

BROWN UNIVERSITY.

Heat; Light; Elementary Text-Books, Theoretical and Practical for Schools and Colleges:

By R. T. GLAZEBROOK. 12 mo., about 220 pages each. New York, Macmillan & Co. Price \$1.00.

These are recent volumes in the series of Cambridge Natural Science Manuals.

All American physicists are familiar with the previous excellent products of Mr. Glazebrook's pen in the line of text-books for laboratory and class-room, and will be interested in this new series which is intended to fill a place quite different from that for which his previous works were prepared. They are less extensive and more elementary. According to the author, they represent what has for some time constituted a practical course for medical students in the Cavendish laboratory. There has been much discussion, and there will continue to be much discussion for some time to come, as to the proper sequence of laboratory, text-book and lecture instruction in elementary physics. In the Cavendish laboratory the system adopted for this course, at least, seems to be that the instructor first presents a portion of the subject in the form of a lecture in which he illustrates, by the use of simple apparatus, and explains the theory of the experiments, deriving principles and numerical results, as far as possible, from the results of experiments actually performed. The members of the class then make the experiments, singly or in pairs, or occasionally in large groups, using the same, or similar, apparatus. The volumes contain descriptions of experiments and also theoretical principles and deductions, so that they constitute at once text-book and laboratory hand-book. At intervals throughout the work there will be found well selected collections of prob-

lems and examples, and a good set of examination questions at the end. The apparatus described is usually simple, and most of it could be made with simple materials by one having some technical skill of the right sort.

It is hardly necessary to say that the theoretical discussions and presentation of principles are, for the most part, clear and clean as far as they go.

In the 'Heat,' the first chapter has to do with its nature, and its relation to work or energy is concisely but clearly stated. In the second chapter the treatment of temperature and its measurement is unusually satisfactory, considering the limitations to which the whole work is subjected. It is to be regretted, however, that there is no mention of the hydrogen scale, since so many of the most important temperature measurements now depend upon it. Calorimetry is discussed quite thoroughly, with many practical illustrations, and in the chapters devoted to expansion several neat suggestions as to methods will be found. In the reference to the necessity for 'compensating' the effect of temperature on the balance wheel of a watch, it is erroneously implied that the principal reason for this grows out of the change in the dimensions, and consequently moment of inertia of the wheel due to change in temperature, while, as a matter of fact, it is the temperature change of the modulus of elasticity of the 'hair' or balance spring which makes nearly all the trouble. The volume ends with a brief but good chapter on the mechanical equivalent of heat.

In the volume on 'Light,' the geometrical treatment is used exclusively. There is a single brief reference to the physical nature of light, which is so thoroughly discussed in the author's volume on 'Physical Optics' published some years ago, but in the book under consideration the rectilinear propagation of a 'ray' is assumed and made the basis of the whole discussion. The chapters

devoted to reflection from plane surfaces are excellent, and those in which refraction is treated are particularly thorough and good. The simpler geometrical treatment of lenses is very satisfactory; optical instruments and 'aids to vision' receive rather more attention (especially the latter) than is usual in books of this class. There are also a number of interesting and rather uncommon experiments and exercises combining the eye and lenses of various forms, by means of which many problems relating to vision are made clear. There is a chapter on the spectrum and color, with which the volume ends.

Both of these volumes can confidently be recommended for courses in secondary schools, or in colleges where a limited amount of elementary instruction in physics is required.

T. C. M.

Electricity, One Hundred Years Ago and To-day. EDWIN J. HOUSTON. New York, W. J. Johnston & Co., Limited. 12mo., pp. 200.

This volume is built around or upon a lecture having the same title which was delivered in 1892. It was a historical discussion of the growth and development of electricity from the beginning (not one hundred years ago) to the present time. In preparing it for publication the author has increased its volume several times, and its interest and value proportionately by the addition of an extensive series of historical foot-notes. Many of these consist of long quotations from original authorities which would have been hardly suitable for a popular address, but which greatly enhance the worth of the address when printed. Some discussions of quite recent date are extensively quoted, and this volume includes, in comparatively small space, the results of much labor expended in the pursuit of exact information by reference to original papers. For this reason, if for no other, it will be welcome to

all interested in the science of electricity or the art of its application.

T. C. M.

Hygiene. By I. LANE NOTTER and R. H. FIRTH. London, Longmans, Green & Co. 1894.

This manual, of 374 pp. 8°, is a very concise and clear summary of what a non-professional, well educated man should know with regard to the general laws of health, the causes of disease, and the best means of combating the latter. Dr. Notter is the Professor of Hygiene in the Army Medical School at Netley, and Examiner in Hygiene in the Science and Art Department at South Kensington, and Dr. Firth is his assistant in each of these positions, hence this manual may be considered as a summary of the latest English teaching on this subject. In such subjects as heating and ventilation, house drainage, construction of buildings, hospitals, etc., its recommendations are adapted especially to the climate and customs of England, and the illustrations are solely of English appliances and methods, and this must be borne in mind by American readers.

Galton's grates, Tobin's tubes, Sheringham valves, Buchan's traps, etc., are not to be found in the market in this country, where other equally satisfactory appliances take their place.

It is not a book to be resorted to for thrilling and sensational quotations, but it will be found to give sound common sense advice upon the subjects of which it treats, and is commended to the readers of SCIENCE as a good manual of reference.

An Illustrated Dictionary of Medicine, Biology and Allied Sciences. By GEORGE M. GOULD, A. B., M. D. Philadelphia, P. Blakiston, Son & Co. 1894. 4°, pp. 1633.

This is a very full and complete dictionary of medicine, printed clearly on good paper, and so bound that it will remain open at any page, a convenience not always

found in books of reference. Some of the words proposed by the author are not accepted by good authorities, as for example, 'chémic' for chemical, 'physiologic' for physiological, and in this respect the work is sometimes misleading. In the attempt to give a complete list of the bacteria many names are given which would not be accepted by a bacteriologist, the list evidently having been prepared by some one not familiar with the subject. These, however, are minor details; the main fact about the work is that it is the most complete and practically useful single volume dictionary of medical terms in the English language, and as such it is commended to the readers of SCIENCE.

NOTES.

THE INTERNATIONAL ZOÖLOGICAL CONGRESS.

THE following invitation has just been issued to the Third International Zoölogical Congress to be held in Leyden next September: "The first International Zoölogical Congress took place in Paris at the time of the International Exhibition of 1889. The second meeting was held in Moscow in 1892. There the resolution was passed that in September, 1895, this Congress would again meet in Leyden, the oldest University of the Netherlands. The Netherlands' Zoölogical Society has taken upon itself to make all the necessary arrangements for the reception and accommodation of the Congress. At the invitation of that Society, the undersigned request you to become a member of the International Congress and to attend the Leyden meeting. It appears probable that different questions, in which the interest of zoölogists in general, as well as those of specialists are involved, can be brought to a solution by mutual exchange of opinions on the occasion of such an international meeting. At any rate the way that will lead to such a solution may there be prepared. Moreover it is undoubtedly a dis-

ting advantage to become personally acquainted with representatives of Zoölogical Science from different parts of the world. As soon as you shall have expressed your sympathy with the above stated aims of the International Zoölogical Congress we shall be glad to be allowed to append your name to a more general invitation directed to all zoölogists and morphologists, which will be brought before our fellow-workers by the aid of different periodicals. We venture to add that even in case of your not being able to attend the proposed Congress you will favor us with the expression of your sympathy with the movement. Pray to be so kind to send your answer to Dr. P. P. C. Hoek, Secretary of the Netherlands Zoölogical Society at Helder, Holland."

The invitation is signed by about one hundred naturalists in different parts of the world, including the following from this country: A. Agassiz, E. D. Cope, E. L. Mark, O. C. Marsh, H. F. Osborn, W. B. Scott and C. O. Whitman.

THE TESTING OF ELECTRICAL STREET RAILWAYS.

THE expenditure and distribution of power on electrical street railways has formed a subject of investigation on a somewhat extensive scale, and for a number of years past, by the departments of Sibley College, Cornell University. In the issue of the *Sibley College Journal* for January, Mr. James Lyman, formerly of Yale University, now engaged in special work of this character in the graduate department of the College, summarizes some of the most important results thus collated. In the performance of the work of investigation, parties are sent out, sometimes to the number of ten or a dozen, including the experts in charge and their student-assistants, divided into squads, assigned each to its special part of the work, the electricians to the measurement of current, the electrical en-

gineers to the handling of the dynamos and electric 'plant,' the mechanical engineers to the testing of engines and boilers, and each individual to that work which he can best direct or with regard to which the experience will prove most fruitful.*

The records of the Sibley College laboratories are thus peculiarly rich in data of this kind. The first case quoted is that of the trial of the Rochester, N. Y., street railway plant by Dr. Bedell, in 1891. The road has about twenty miles of track, and very easy gradients. The traction demanded 1.4 *E. H. P.* per ton, at 6.5 miles average speed, efficiency of line was 90 per cent., that of the station 64.8 per cent., and there were needed, at the engines, 2.4 *I. H. P.* per ton, 20 *I. H. P.* per car. The Buffalo plant was tested in 1892, under the responsible direction of Messrs. Wood and Palmer. The average power demanded was 1.76 *I. H. P.* per ton. The Ithaca street railway was tested in 1894, and is important as illustrating work on heavy gradients, averaging about nine per cent., a maximum occurring at twelve or thirteen. The traction coefficient was found to be 40 pounds, per one per cent. of gradient and per ton. In a level country, the estimate for power to be provided at the station is put at 2.5 *I. H. P.* per ton of car and load, the number of cars on the line averaging about ten. If averaging twenty, the figure becomes 2.2.

* As many as a dozen indicators and numerous volt and ammeters, dynamometers, special condensing apparatus, scales for weighing coal and water, and similar test apparatus are often supplied by the College, the resources of which are gauged, in a way, by the fact that it furnishes a large part of its graduating classes of late years, numbering about a hundred, with all the instruments needed in work of investigation in their graduating theses; which theses are usually accounts of such work. Its working 'plant' includes fifteen steam engines, seven gas engines, some fifty gauges and a still larger number of steam engine indicators.

THE MINNESOTA ACADEMY.

THE Minnesota Academy of Natural Sciences has, in addition to its 'Bulletin,' instituted a new series of publications termed 'Occasional Papers.' It is intended that in this series shall be published researches of considerable importance. Vol. I., No. 1, which has recently appeared, contains 'Preliminary Notes on the Birds and Mammals collected by the Menage Scientific Expedition to the Philippine Islands,' by Frank S. Bourns and Dean C. Worcester.

ANTHROPOLOGY.

UNDER the title of 'Notes on Primitive Man in Ontario,' by David Boyle, there has been printed in Toronto, by order of the Legislative Assembly, as an appendix to the report of the Minister of Education, Dr. G. W. Ross, a pamphlet of about 100 pages, containing much instruction concerning the aboriginal tribes of that province. Mr. Boyle has been for many years the efficient curator of the valuable Ethnological Museum of the Canadian Institute. This monograph comprises many pictures of the native implements of stone, clay, bone, horn, shell and copper in that museum, and will be useful to ethnologists for purposes of comparison.

Tsetsaut is the Tsimshian name of a small tribe recently discovered on Portland Inlet, British Columbia, 54° 50' Lat., which consists at present of twelve Indians only. They live on the proceeds of hunting and fishing and originally spoke a Tinné or Athapaskan dialect, which is evidenced by the fact that two of their number still remember words of it, though the rest speak the Nass dialect of the Tsimshian Indians surrounding them. Even the original Tinné name of the tribe is no longer remembered. Dr. Franz Boas studied the tribe during the later months of 1894, and also discovered another remnant of the same linguistic family, the Tinné, which lives in the vicinity. He favors, somewhat,

the theory that Haida, Tlinkit and Tinné are related to each other, and that after a more thorough study the three will be found to form one and the same linguistic family. Dr. Boas' discovery is remarkable for this reason, that the great Tinné family is almost exclusively an inland nation, and has pushed its branches to the ocean only at two places, viz., in Southern Texas (Lipans) and in Southwestern Oregon (Rogue Rivers), contiguous to the northwest coast of California, where little Tinné tribes have settled also.

Alaska. This name was originally applied only to the narrow peninsula situated at the southwest extremity of the Alaska Territory. It is a corruption of alákshak, *mainland, continent*, a term of the Eastern dialects of the Ale-üt language. The name of *Unalashka Island* contains the same word, for it is contracted from ángun alákshak, 'to the west of the mainland.' Ángun, *west*, also enters into the composition of Unángun, a division of the Ale-üt people, which is reducible to un, *people*, and ángun, *west*. (From notes by Ivan Petróff.)

THE Department of Anthropology, University of Chicago, has just published Bulletin 1—*Notes on Mexican Archaeology*, by Frederick Starr. A full description is given of the ruins of an interesting 'painted house' at San Juan de Teotihuacan. The walls were decorated with pictures, in a variety of colors, representing warriors and religious personages. The designs are reproduced in a series of a dozen cuts. Some notes are also given regarding Mitla and Monte Alban. Paintings from a wall at Mitla are reproduced in full size.

It is the intention of the University to publish Bulletins in this Department from time to time as fresh material is secured.

ZOOLOGY.—THE MAMMALS OF FLORIDA.

MR. FRANK M. CHAPMAN has recently published a list of the Mammals known to

inhabit the State of Florida (Bull. Amer. Mus. Nat. Hist. vi. pp. 333-346). He gives in all, the names of 53 species and sub-species. Aquatic species are excluded. The largest forms are the Virginia deer, the black bear, the puma and the wolf. The last-named is approaching extinction. The beaver is believed to occur in the Chipola River.

The sole West Indian form is a leaf-nosed bat (*Artibeus carpolegus*), and this is believed to be only an accidental visitant. The house-rat of Florida is the white-bellied roof rat (*Mus alexandrius*) rather than the Norway rat. F. W. T.

GEOLOGY.

AT a meeting of the Council of the Michigan Academy of Sciences, Messrs. A. C. Lane and I. C. Russell were appointed a committee to present to the Legislature a plan for a topographical survey of Michigan. The plan to be proposed will be in coöperation with the U. S. Geological Survey and the preparation of a map similar to the maps of Massachusetts, Rhode Island and Connecticut, recently compiled at the joint expense of the States named and the U. S. Geological Survey.

PROFESSOR J. E. TODD, State Geologist of South Dakota, has just issued his first report. It is entitled 'South Dakota Geological Survey, Bulletin No. 1: A Preliminary Report on the Geology of South Dakota.' In this volume the present state of knowledge concerning the geology of the State is presented briefly and in a form that is acceptable to the intelligent citizen as well as to the specialist. The report is an octavo of 172 pages, and it is accompanied by several plates and a geological map of the State.

THE committee appointed by the members of the Johns Hopkins University to mature a plan for securing a permanent memorial of the late Professor George Huntington Williams are able to announce

that subscriptions have been received of a sufficient amount to procure a portrait in oil, which will soon be completed and presented to the University. The artist selected is Mr. Robert G. Hardie, of New York.

ENTOMOLOGY.

In a paper read to the K. Böhm. Gesellschaft der Wissenschaften on November 23d last, Dr. Anton Fritsch, of Prag, announced the discovery in the Permian beds of Bohemia of the larval cases of a caddis-fly. This is the first indication of the existence of insects with a complete metamorphosis in paleozoic times, unless the doubtful fragments found by Dathe in Silesian culm are to be regarded as shards of beetles, or the passages found in certain carboniferous woods are to be credited to coleopterous larvæ. It is to be hoped that Dr. Fritsch will amply illustrate these remains in his great work now in progress on the Fauna der Gaskohle Böhmens.

GENERAL.

PROFESSOR WARBURG, of Freiberg, has been called to Berlin as the successor of Kundt.

PROFESSOR KULZ, of Marburg, known for his researches in physiological chemistry, died on January 16.

MACMILLAN & Co. announce a translation by Dr. A. C. Porter, of the University of Pennsylvania, of the *Lehrbuch der Botanik*, by Strasburger, Noll, Schenck and Schimper.

THE St. Petersburg Academy of Sciences has recently made some changes in the system of publishing papers communicated to it. In September, 1894, it commenced the publication of a monthly number, under the title *Bulletin de l'Académie Impériale des Sciences*, which serves as the organ of the three classes of the Academy. This *Bulletin* is intended to include the *procès-verbaux* of the meetings, annual reports of scientific researches, reports on prizes conferred by the Academy, notes on the work of the

museums, &c. In addition to notices of this kind, the *Bulletin* will contain short scientific papers. The *Mémoires de l'Académie Impériale des Sciences* will form in future the second means of publication. It will be divided into two independent series, dealing respectively with the physico-mathematical section of the Academy's papers, and the historical and philological section. The publication of the *Mélanges, tirés du Bulletin*, has been discontinued.—*Nature*.

AN International Congress on Childhood will be held in Florence in the spring of 1895. Among the questions to be discussed are the physical, moral and mental elevation of children, children's hospitals, the care of deaf-mute and blind children up to the time of their admission into an educational institution, care of poor and abandoned children, reformatories, and vagabondage in its relation to childhood.—*N. Y. Medical Record*.

SOCIETIES AND ACADEMIES.

A. A. A. S. MEETING, 1895.

At a special meeting of the Council, held on January 26th, it was decided to postpone the proposed meeting in San Francisco. An invitation from Springfield, Mass., to hold the meeting of 1895 in that city, was accepted. The date of the meeting was fixed as follows: Council meeting, Wednesday, August 28th, at noon; General Sessions, Thursday, August 29th, at 10 A. M.

Special efforts will be made by the officers of the sections to prepare programmes for the sections in advance of the meeting and for this purpose members are requested to send abstracts of their papers, as early as possible, to the Permanent Secretary, or to the Secretaries of the Sections.

F. W. PUTNAM, *Permanent Secretary*.

SALEM, MASS., Jan. 30, 1895.

NEW YORK ACADEMY OF SCIENCES; SECTION OF ASTRONOMY AND PHYSICS, FEB. 4.

PROFESSOR W. HALLOCK showed a new

photographic method of comparing the rate of vibration of two tuning forks. The forks are so clamped that a prong of each is held in front of a manometric capsule. The forks are bowed and the flames photographed as described in the *Physical Review*, Vol. II., p. 305, 1875. The vibrations are then counted in the wavy line on the negative. The accuracy in ordinary work is about two or three-tenths of a wave per second.

The second paper was by Prof. J. K. Rees on the *Penumbra of sun-spots* as shown in Rutherford's photographs, with especial reference to the discussion at the December meeting of the Royal Astronomical Society. Professor Rees called the attention of the Section to the remarks made by the Rev. F. Howlett on presenting to the Royal Astronomical Society of London three volumes of sun-spot drawings. This set of volumes contains drawings made during a period of thirty-five years, and shows minute details in regard to the forms and changes of solar spots. The Rev. Mr. Howlett stated that his main object in continuing the series had been to test the theory put forth by Professor Wilson, of Glasgow, in the latter part of the last century. Wilson's theory claimed that the penumbra in a spot shelves down toward the umbra; and that the portion of the penumbra nearest the sun's centre will, therefore, grow narrower and narrower, due to perspective, as the sun-spot reaches a point nearer and nearer to the limb. Mr. Howlett claimed that his drawings showed that the Wilsonian theory was not borne out by his observations as recorded in his drawings.

He made bold to say that, instead of the penumbra of the spot possessing shelving sides sloping down toward the umbra, the penumbra shows a convex surface in a curve conformable to the general contour of the solar surface. He remarked that he had not himself witnessed a single case of certain notching of the limb.

Professor Rees exhibited on the screen a series of fine photographs of the solar surface taken by Mr. Rutherford with his photographic telescope (13 inches diameter of object glass, 11 feet of focal length) during the years 1870-1871. Attention was called to the appearance of the penumbral regions of the spots which showed conclusively that the penumbra was, as a rule, eccentric with respect to the umbra. Spots were pointed out near the centre of the sun where the penumbral marking was deficient on, sometimes the west side, then on the east side, sometimes on the north side and sometimes on the south side. Spots were also indicated which showed, when near the limb of the sun, the penumbral region wanting on the side farthest from the centre and well developed on the side toward the centre. So far as these photographs showed, there was no doubt that the Wilson theory did not completely explain the various phenomena.

Professor Rees also showed some pictures of sun-spots taken by Mr. C. A. Post, of New York City, exhibiting the non-central character of the umbra with respect to the penumbra. Mr. C. A. Post, of New York City, then threw on the screen some photographs of the sun and moon that he had taken.

He also exhibited a series of strikingly beautiful lantern slides made from photographs of lightning flashes.

Professor M. I. Pupin described his *new form of automatic vacuum-pump* (see *Am. Journ. Sci.*, Vol. 39, 1895, p. 19). An extremely ingenious device utilizes an ordinary vacuum pump (water pump) to raise mercury for the Sprengel pump. Little mercury is needed and the whole is continuous in its action.

INDIANA ACADEMY OF SCIENCE.

The Indiana Academy of Science met at Indianapolis, December 27-28, 1894, with W. A. Noyes, of the Rose Polytechnic of

Terre Haute, as President, and C. A. Waldo, of De Pauw University, as Secretary.

The Academy was well attended by the leading scientists of the State.

After the ordinary preliminary business, the body continued in general session, and listened to the reading of nine papers on general scientific topics.

The Academy then met in two sections, Physico-Chemical and Biological. In the former section, 28 short papers were read, and in the latter 51. The papers indicated that much work had been done during the past year in the various lines of scientific investigation.

The reports from the directors of the Biological Survey of Indiana were encouraging, showing that every effort was being put forth to accomplish this survey as quickly as possible and in a satisfactory manner. A resolution was passed requesting the Legislature of the State to print and distribute the proceedings of the Academy. This expense has always been borne by the Academy, but in view of the fact that the State is reaping the benefits it should assume the expense.

The Spring meeting will be held at the Wyandotte Cave, in Crawford county.

Following is a list of the papers:

Address by the Retiring President,—Lavoisier.

W. A. NOYES.

GENERAL SUBJECTS.

1. *Some Facts in Distribution of Gleditschia Triacanthos and Other Trees*: Ernest Walker.
2. *Propagation and Protection of Game and Fish*: I. W. Sharp.
3. *Anthropology; the Study of Man*: Amos W. Butler.
4. *A New Biological Station and its Aim*: C. H. Eigenmann.
5. *Transmission of Impressions in Spinal Cord*: G. A. Talbert.
6. *Does High Tension of Electric Current Destroy Life*: J. L. Campbell.

7. *The Surduc Engineering Laboratory since the Restoration*: Wm. F. M. Goss.

8. *Method of Determining Sewage Pollution of Rivers*: Chas. C. Brown.

9. *Psychological Laboratory of Indiana University*: W. L. Bryan.

PHYSICO-CHEMICAL SUBJECTS.

10. *Interesting Deposit of Alumina Oxhydrate*: G. W. Benton.

11. *Observations on Glacial Drift of Jasper County*: A. H. Purdue.

12. *Concerning a Burial Mound Recently Opened in Randolph County*: Joseph Moore.

13. *Reversal of Current in the Toepler Holtz Electrical Machine*: J. L. Campbell.

14. *A Florida Shell Mound*: U. F. Glick.

15. *Note on Rock Flexure*: E. M. Kindle.

16. *The Alternate-Current Transformer with Condenser in one or both Circuits*: Thomas Gray.

17. *Elastic Fatigue of Wires*: C. Leo Mees.

18. *A Warped Surface of Universal Elliptic Eccentricity*: C. A. Waldo.

19. *Accurate Measurements of Surface Tension*: A. L. Foley.

20. *Effect of the Gaseous Medium on the Electrochemical Equivalent of Metals*: C. Leo Mees.

21. *Some new Laboratory Appliances in Chemistry*: H. A. Huston.

22. *Volumetric Determination of Phosphorus in Steel*: W. A. Noyes and J. S. Royse.

23. *Action of Ammonia upon Dextrose*: W. E. Stone.

24. *Action of Zinc Ethyl on Ferric Chloride and Ferric Bromide*: H. H. Ballard.

25. *The Sugar of the Century Plant*: W. E. Stone and Dumont Lotz.

26. *Camphoric Acid*: W. A. Noyes.

27. *Action of Potassium Sulfhydrate upon Certain Aromatic Chlorides*: Walter Jones and F. C. Scheuch.

28. *A New Phosphate*: H. A. Huston.

29. *Dip of the Keokuk Rocks at Bloomington, Ind*: Edward M. Kindle.

30. *Structural Geologic Work of J. H. Means in Arkansas*: J. C. Branner.

31. *Wave Marks on Cincinnati Limestone*: W. P. Shannon.

32. *Correlation of Silurian Sections in Eastern Indiana*: V. F. Marsters and E. M. Kindle.

33. *Some New Indian Fossils*: C. E. Newlin.

34. *Extinct Fauna of Lake County*: T. H. Ball.

35. *Strepomatidæ of the Falls of the Ohio, with their Synonymy*: R. Ellsworth Call.

36. *Streams of Southeastern Indiana, with List*: H. M. Stoops.

37. *The Swamps of Franklin County*: H. M. Stoops.

BIOLOGICAL SUBJECTS.

38. *Water Cultures of Indigenous Plants*: D. T. MacDougall.

39. *Working Shelves for Botanical Laboratory*: Katherine E. Golden.

40. *New Apparatus for Vegetable Physiology*: J. C. Arthur.

41. *Collections of Plants made during the Year*: M. B. Thomas.

42. *The Flowering Plants of Wabash County*: A. B. Ulrey and J. N. Jenkins.

43. *Revision of the Phanerogamic Flora of the State*: Stanley Coulter.

44. *Report of Progress of the Botanical Division of the State Biological Survey*: L. M. Underwood.

45. *Value of Seed Characters in Determining Specific Rank in the Genus Plantago*: Alida M. Cunningham.

46. *Additions to the Fish Fauna of Wabash County*: W. O. Wallace.

47. *Notes on the Reptilian Fauna of Vigo*: W. S. Blatchley.

48. *Preliminary List of Birds of Brown County*: Edward M. Kindle.

49. *The Birds of 1893*: Amos W. Butler.

50. *Some Notes on the Blind Animals of Mammoth Cave, with Exhibition of Specimens*: R. Ellsworth Call.

51. *The Batrachians and Reptiles of Wabash County*: W. O. Wallace.

52. *On the Occurrence of the Whistling Swan (*Olor columbianus*) in Wabash County*: A. B. Ulrey.

53. *Birds of Wabash County*: A. B. Ulrey and W. O. Wallace.

54. *Birds Observed in the Sawtooth Mountains*: B. W. Evermann and J. T. Scovell.

55. *Animal Parasites Collected in the State during the year 1894*: A. W. Bitting.

56. *Angling in the St. Lawrence and Lake Ontario*: Barton W. Evermann.

57. *Indiana Mammals*: Amos W. Butler.

58. *Mimicry in Fishes*: W. J. Moenkhaus.

59. *Variation in Leuciscus*: C. H. Eigenmann.

60. *The Redfish of the Idaho Lakes*: B. W. Evermann and J. T. Scovell.

61. *Observations upon Some Oklahoma Plants*: E. W. Olive.

62. *Rediscovery of Hoy's White Fish or Moon-eye (*Argyrosoma hoyi*)*: Barton W. Evermann.

63. *Saxifragaceæ of Indiana*: Stanley Coulter.

64. *The Range of the Blue Ash*: W. P. Shannon.

65. *Plant Products of the U. S. Pharmacopæa (1890)*: John S. Wright.

66. *Noteworthy Indiana Phanerogams*: Stanley Coulter.

67. *Methods of Infiltrating and Staining in toto the Heads of Vernonia*: E. H. Heacock.

68. *Embryology of the Ranunculaceæ*: D. M. Mottier.

69. *Certain Chemical Features in the Seeds of Plantago Virginiana and P. Patagonica*: Alida M. Cunningham.

70. *Root System of Pogonia*: M. B. Thomas.

71. *Salt-rising Bread*: Katherine E. Golden.

72. *An Increasing Pear Disease in Indiana*: L. M. Underwood.

73. *Notes on the Floridæ*: Geo. W. Martin.

74. *Measurement of Strains Induced in Plant Curvatures*: D. T. MacDougal.

75. *The Stomates of Cyas*: Edgar W. Olive.

76. *The Buckeye Canoe of 1840*: W. P. Shannon.

77. *Embryo-Sac of Jeffersonia Diphylla*: Frank M. Andrews.

78. *Cell Structure of Cyanophyceæ*: Geo. W. Martin.

79. *Some Notes on the Amoeba*: A. J. Bigney.

80. *Variations of the Polyporus lucidus*: L. M. Underwood.

81. *Preliminary Account of the Development of Etheostoma Cæruleum*: A. B. Ulrey.

82. *Embryology of the Cupuliferæ*: D. W. Mottier.

83. *Embryology of the Frog*: A. J. Bigney.

84. *Variation in Etheostoma*: W. J. Moenkhaus.

85. *Blood Corpuscles of very Young Human Embryo*: D. W. Dennis.

86. *Poisonous Influences of some Species of Cypripedium*: D. T. MacDougal.

87. *Development of Sexual Organs of Cymatogaster*: C. H. Eigenmann.

88. *The Vegetation House as an Aid in Research*: J. C. Arthur.

89. *The Proposed New Systematic Botany of North America*: L. M. Underwood.

SCIENTIFIC JOURNALS.

ASTROPHYSICAL JOURNAL, FEB.

On a Lens for Adapting a Visually Corrected Refracting Telescope to Photographic Observations with the Spectroscope: JAMES E. KEELER.

Schmidt's Theory of the Sun: E. J. WILCZYNSKI.

A Cloud-Like Spot on the Terminator of Mars: A. E. DOUGLASS.

Preliminary Table of Solar Spectrum Wave-Lengths. II.: H. A. ROWLAND.

Photographic Observations of Jupiter's Satellites: WILLARD P. GERRISH.

The Arc-Spectra of the Elements. II. Ger-

manium: H. A. ROWLAND and R. R. TATNALL.

Comparison of Photometric Magnitudes of the Stars: EDWARD C. PICKERING.

The Spectrum of δ Cephei: A. BELOPOLSKY.

Minor Contribution and Notes; Reviews; Recent Publications.

NEW BOOKS.

Butterflies and Moths. W. FURNEAUX. London and New York, Longmans, Green & Co. 1894. Pp. xiv+358. \$3.50

Elements of Astronomy. GEORGE W. PARKER. London and New York, Longmans, Green & Co. 1894. Pp. 236. \$1.75.

Steam and the Marine Steam-Engine. JOHN LEO. London and New York, Macmillan & Co. 1894. Pp. xiv+196. \$2.50.

Memoir of Sir Andrew Crombie Ramsay. SIR ARCHIBALD GEIKIE. London and New York, Macmillan & Co. 1895. Pp. x+397. \$4.00.

Meteorology. THOMAS RUSSELL. London and New York, Macmillan & Co. 1895. Pp. xxiii+277. \$4.00.

The Supremacy of the Spiritual. EDWARD RANDALL KNOWLES. Arena Publishing Co. 1895. Pp. 61.

The International Beginning of the Congo Free State. JESSIE SIDDALL REEVES. Baltimore, Johns Hopkins University Press. 1894. Pp. 106.

Report of work of the Agricultural Experiment Stations of the University of California; Being a Part of the Report of the Regents of the University. Sacramento, 1894. Pp. 506.

The Cause of Warm and Frigid Periods. C. A. M. TABER. Boston, Ellis. 1894. Pp. 80.

Electrical Engineering for Electric Light Artisans and Students. W. SLINGS and A. BROOKER. London and New York, Longmans, Green & Co. New and Revised Edition. 1895. 8°, pp. vii+753. 346 illustrations.